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Flax Production in South Dakota

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Flax is grown in South Dakota at the rate of 6 to 9 million bushels a year, making it one of our major cash crops. In counties where the major acreage is grown, cash income from flax ranks with other cash crops. And, in these areas, growers often realize an additional income by selling flax straw.

Marketed flax seed is used commercially for the production of linseed oil with linseed oil meal as a valuable by-product. A bushel of flaxseed will yield about 19 pounds or 2½ gallons of oil. The flaxseed oil or linseed oil is used in the manufacturing of paint, varnish, linoleum, highway protective treatments, and many other commercial products. Linseed meal is an important livestock feed.

Flax growers have enjoyed a ready market for their crop. Flax has not been in the high surplus crop category and carryover has been at a relatively low level. The flax crop is facing strong competition from other oilseed crops, from oil imports and from non-agricultural synthetic materials. Surplus seed stock and price fluctuations will depend to some degree on national yearly production, and production by competitive nations, particularly Canada and Argentina, both large flax producers. Normally, about 80 percent of the United States' crop is consumed locally, leaving 20 percent for export trade.

Recent research has improved the old uses for flaxseed oil and also has opened the way for new uses of flaxseed and flax by-products. This has direct bearing on the economics of flax production and on making it more competitive with other crops.

Expected Flax Yields

Flax yields have fluctuated from one year to another indicating that rainfall and growing conditions do have a definite influence. The annual average yield, according to the South Dakota Crop and Livestock Reporting Service, has varied from a low of 8.5 bushels to a high of 14 bushels per acre. However, the potential yield and even the annual average yield can be signficantly greater than what is being reported. The more successful flax growers are aiming for and getting 20 bushels or more per acre.

Thirty bushels per acre are possible and economically feasible when proper cultural and management proctices are employed.

The main purpose of this fact sheet is to set forth those production practices and principles essential to growing flax and attaining maximum yields.

General Production Requirements

The major flax producing area of South Dakota is in the northeast counties. In that area, under proper cultural practices, flax is a relatively low risk crop. Moderate summer temperatures and adequate rainfall make for favorable growing conditions. When flax is grown west and south of the flax producing area, however, it becomes a high risk crop with less economic advantage.

In order to be a successful flax grower, follow these cultural practices:

1. Follow timely moisture saving tillage practices.
2. If the field has a 3 percent slope or more plant on the contour to prevent water runoff.
3. Sow on land where weeds were controlled the previous year.
4. Plant high germinating seed in a firm, well prepared seedbed.
5. Plant early.
6. Plant in good, fertile soil; have a soil test made previously to determine fertility needs.

Flax in the Rotation

Flax can fit into many rotations or sequence of crops. It is a poor "weed competitor" so consideration must be given to any possible weed problem. Do not plant flax on land where a weed problem existed the previous year.

Flax often follows corn or other row crops which is very satisfactory, provided weeds were controlled through clean cultivation. Much of the flax in the flax producing area is often sown after small grain. Flax is a very good crop to plant on grassland being put back to cropland. The land should be plowed in August to permit some breakup of the sod during the fall and winter months. The fact that flax is a poor "weed fighter" makes this crop a "good companion" for establishing grass and legume seedings. Flax on fallow land is good providing weeds have been controlled. The extra supply of available nitrogen on fallow can stimulate weed growth and take over flax. The flax producer does have access to herbicides and, if they are used and managed properly, he can usually keep weed problems under control.

Weed Control

Following recognized cultural weed control practices is essential for successful flax production. When flax is to follow small grain, a tillage operation soon after the small grain harvest will help control perennial weeds, prevent seed production, and stimulate fall germination of weed seeds. Shallow tillage before seeding flax reduces the possibility of bringing weed seeds near the surface to germinate. Crop rotations can be an effective means of weed control. Chemical methods also may become necessary in controlling some weeds under certain conditions.

A common sight each fall especially in northeastern South Dakota is the flax harvest. Flax is a relatively low risk crop in this part of the state where favorable summer temperature variations and adequate rainfall result in ideal growing conditions.

Use MCPA amine or ester to control susceptible broadleaved annual weeds. Use up to ¼ pound acid equivalent of MCPA per acre. Apply when flax is 2 to 6 inches tall and before it is in the bug stage. Weeds should be less than 4 inches tall.

Use dalapon (tradename Dowpon or Basifapon) to control foxtails or barnyardgrass. Apply ¾ pound acid equivalent of dalapon (1 lb. product) per acre. Apply when the flax is 2 to 6 inches tall, and before weeds are over 2 inches tall. Dalapon and MCPA amine may be tank-mixed at the above rates to control annual grasses and broadleaved annual weeds in one spray operation.

Use bromoxynil (tradename Brominal or Buctril) to control wildbuckwheat. Apply ¼ pound acid equivalent (1 pt. product) per acre when the crop is 2 to 8 inches tall.

Use diallate (tradename Avadex) or barban (tradename Carbyne) to control wild oats. Apply diallate preplant or preemergence at the rate of 1½ pounds active ingredient (1½ qt. product) per acre. Apply to a smooth soil surface and incorporate to a depth of ½ to 1½ inches. Use ¼ to ⅜ pound active ingredient of barban (¼ to ⅓ gal. product) per acre. Apply when the wild oats are in the 2-leaf stage and not later than 14 days after crop emergence or before the 12-leaf stage of the flax. Do not graze unharvested crop treated with diallate.

Use MCPA amine to control annual broadleaved weeds in flax underseeded to legumes .Use ¼ pound acid equivalent of MCPA per acre.

Fertilizing Flax

Flax, like virtually every other crop, requires optimum soil fertility for optimum yields, particularly as it pertains to nitrogen. The production of each bushel of flax removes approximately 3.2 lbs of N, 0.9 lbs of P_2O_5, and 2.7 lbs of K_2O. This perhaps better explains the importance of adequate nitrogen. Five to ten bushel yield increases to recommended rates of nitrogen are not uncommon, where deficient soil nitrogen-supplying ability exists. Soil phosphorus and potassium levels, however, must test low to very low before profitable yield increases can consistently be obtained from applications of those fertilizer materials. Soil test nitrogen recommendation rates will vary from 20 to 80 lbs. of N, depending on soil test levels and yield potential. Recommended phosphorus and potassium fertilizer rates will vary from 0 to 50 lbs and 0 to 120 lbs., respectively. again depending on soil test levels and yield potential.

Fertilizer placement can be very critical in flax production. For example, applying the entire recommended nitrogen rate down the tube with the seed will frequently cause reduced stands and yield due to seedling injury.

Potential flax seedling damage can occur whenever the combined total rates of nitrogen and potash exceed 15 lbs. per acre, consequently rates in excess of this should be plowed down for the best consistent results. Shallow surface mixing of broadcast fertilizer is not recommended because it frequently stimulates weed competition at the expense of flax growth, thereby limiting yields.

Seedbed Preparation

Proper seedbed preparation is one cultural practice in flax production that must not be neglected. It should

include weed control, shallow tillage for moisture conservation, and a firm seedbed to permit shallow planting.

If time permits and if flax is to follow corn, fall disking of the corn stalks will help speed up the rotting of the corn residue and will make for easier preparation of the seedbed in the spring. The residue needs to be well cut-up and incorporated into the soil so it will not interfere with uniform depth of planting of the flax seed. Early spring plowing or fall plowing where wind erosion is not a problem is suggested where the field will be plowed. This will allow for a couple of shallow tillage operations before the flax is seeded which will stimulate early weed seed germination, destroy weed seedlings and make for a firm seedbed. Soybean land will need only a light disking before seeding the flax.

The plow, packer, and pony-press drill is an excellent once over seedbed preparation and seeding method for flax. This is becoming the most popular method, regardless of the previous cultivated crop.

Early Seeding Usually Best

Long time records of the South Dakota Agricultural Experiment Station show that the optimum planting date for flax is April 15 to April 25. Flax varies in its reaction to frost. On the average, light frosts do little damage and in some seasons very heavy freezees have had little effect on flax yield. The critical time for frost injury is at the small seedling stage. Because cool weather favors the growth of flax seedlings, early planting often makes it possible to get a head start on many troublesome weeds common to flax (foxtails and other warm season types).

Sometimes, because of drought, excessive moisture or a wild oats problem, it becomes necessary to delay planting. Research shows that early to medium-early maturing varieties should be selected for late plantings. This is important.

Method of Planting

Flax can be seeded best with a grain drill in a level, firm seedbed. If seeded into a loose seedbed, there is danger of planting the seed too deeply, the main reason for poor stands and slow seedling emergence. The press drill is superior to the regular grain drill since it permits more accurate control of depth and also packs the soil above each drill row. The pony-press drill, as previously mentioned, has been used successfully and is highly recommended for flax. The pony-press drill has the advantage of placing the seed in moist soil and packing the soil. The packing promotes rapid germination, letting the flax get ahead of the weeds.

Plant flax seed relatively shallow. Actual planting depth is determined somewhat by soil texture and moisture condition. In heavy soil, ½ to 1 inch is usually deep enough. But on lighter soils, 1 to 1½ inches is better.

Rate of Seeding

Rate of seeding per acre will vary with size of seed, rainfall, time of seeding, and germination. In eastern counties of South Dakota—where rainfall is usually more adequate than outside the flax producing area—the recommended rate of seeding for medium to large seeded varieties is 42 to 56 pounds per acre. For small seeded varieties, rate of seeding can be reduced by one-fourth. These seeding rates are for seed with germination of 90 percent or higher. *Test all seed for germination before planting.* As a general rule for rate of seeding, adjust the drill to sow four to five seeds per inch in the drill row.

Harvesting

Flax does not shatter or lodge as easily as small grains, and therefore can be left standing until seed is fully mature, with little danger of loss in yield or quality. When 90% of the bolls turn brown, the flax is ready to harvest. When harvest is delayed, a decrease in percent of germination may be noted.

Flax is a difficult crop to cut. It should be harvested with a combine or swather that is in good running order and has a sharp sickle.

Clean standing flax, free of weeds, can be straight combined if moisture content of seed is below 12 percent. Because of green weeds and uneven ripening, most operators cut flax with a windrower and allow it to dry in the swath. Moisture in green flax bolls or green foreign material can lower the quality of harvested seed.

Flax in the windrow should be combined as soon as the moisture in the seeds is below 12 percent. Flax windrows are not too stable in a strong wind and can be rolled together, or end-up in the fence row, or in the roadside ditch. The quality will deteriorate in a rainy period.

Harvest and Storage Care

Take special care to prevent cracking or injury to seed during threshing or other handling. Cracked seed often causes poor germination. Lowering combine cylinder speeds and speeds of other machines handling flaxseed helps prevent cracking and excessive injury to the seedcoat. Cylinder teeth must be properly aligned. Rubbar-type cylinder combines have been satisfactory when adjusted and operated properly.

Flaxseed cannot be stored safely until moisture content is 11 percent or less.

Flax Straw

Flax producers can receive extra income by selling their flax straw. Length and freedom of weeds and disease are the qualities which flax straw buyers seek. Top flax straw yields, as well as higher seed yields, may be obtained by following good weed control and fertility practices. An acre of flax will yield from 700 to 2,000 pounds of straw depending on length and density of the stand. Flax straw is used for manufacture of high quality papers, such as cigarette paper and Bibles.

Flax straw is mainly composed of cellulose and decomposes very slowly in the soil. It should be chopped when a producer plans to incorporate it into the soil. The organic material lost by removing the straw can be replaced by seeding a legume with flax for plow-down purposes.

Flax Diseases

WILT: This is a soil-borne fungus disease which can attack a susceptible plant in all stages of its development. In typical wilt, leaves turn yellow or grayish-

Flax Varieties

Variety	Yield	Maturity	Plant Height	Seed Size	Seed Color	Flower Color	Oil Content	Oil Quality	Diseases* Rust	Diseases* Wilt	Diseases* Pasmo
Recommended:											
Culbert	High	Early	Medium	Medium	Brown	Blue	High	Medium	I	R	MR
Linott	High	Early	Medium	Medium	Brown	Blue	High	Medium	I	MS	S
Norstar	High	Med. Late	Med. Tall	Medium	Brown	Blue	High	Medium	MR	R	MS
Not Recommended:											
B-5128	High	Late	Tall	Medium	Brown	Blue	Medium	Fair	S	MR	S
Bolley	Medium	Med. Late	Medium	Medium	Brown	Blue	High	High	S	R	S
Foster	Medium	Med. Late	Medium	Medium	Yellow	Dk. Blue	V. High	Medium	I	MR	MS
Nored	High	Med. Late	Med. Tall	Medium	Brown	Blue	High	High	S	R	MR
Raja	Low	Early	Medium	Medium	Brown	Blue	Low	Fair	I	MS	MS
Redwood 65	High	Med. Late	Medium	Medium	Brown	Blue	Medium	Medium	S	R	S
Summit	High	Med. Early	Medium	Medium	Brown	Blue	Medium	Medium	S	R	S
Windom	High	Med. Early	Medium	Medium	Brown	Blue	Medium	High	S	R	S

*Symbols used to indicate degrees of resistance or susceptibility to diseases are: I=immune; R=resistant; MR=moderately resistant; S=susceptible; MS=moderately susceptible; VS=very susceptible.

yellow, top leaves may thicken, growth stops and the plants die and turn light brown. Frequently, the plant is only stunted, in which case leaves turn yellow and fall prematurely, or the primary stem dies and new, apparently healthy lateral branches develop from the first node. A late infection or a weak attack may be evidenced by premature ripening. At one time, wilt was the most widespread and destructive disease of flax. Resistant varieties, when available, offer the best means of control.

RUST: Light-yellow, orange-yellow, or reddish-yellow spore masses occur on the surface of leaves, stems and bolls. Rust reduces seed yield and quality. In 1951 loss in the United States exceeded $10 million.

New races of rust are occasionally produced in nature which have the ability to attack previously resistant varieties. For example, in 1962 the appearance of race 300 resulted in the removal from the list of recommended varieties, the grower-accepted but susceptible varieties, Arne, Marine, and Marine 62.

More recently, rust races 370, 371, and 372 were found in South Dakota. While these new races did not cause economic loss in 1973, race 370, in particular, was very widespread on susceptible varieties in the more important flax-growing areas of South Dakota, North Dakota, Minnesota and Canada. Races 371 and 372 were apparently not as widespread as race 370. Continued planting of susceptible varieties could favor a rapid build-up of these new races and possibly lead to considerable economic loss. Accordingly, the recommended variety situation had to be changed drastically. Linott, Raja, and Foster are highly resistant to these current races. However, Raja and Foster generally yield

Sale of flax straw gives an additional profit to growers. Frequently huge stacks of the baled straw are seen in South Dakota flax growing regions.

less and are not as agronomically desirable as the other varieties. Summit is very susceptible and the use of this variety should be strongly discouraged. Other varieties, such as Norstar, Nored, Windom, B-5128, and Bolley show a moderate level of field resistant based on field observations in North Dakota during 1974. The use of these varieties does create a risk factor compared to the relative safety of using a highly resistant variety.

The grower is protected by selecting rust resistant varieties. Linott is the only recommended variety available in large enough quantities for seeding the anticipated flax acreage in 1975 and 1976. By 1976, there should be one new additional highly-resistant variety available to growers. That variety is Culbert.

PASMO: This fungus disease is recognized by circular, greenish-yellow to dark brown spots on the leaves. As the disease develops, the stems become infected and all infected leaves may turn brown, die and drop off. Infected stems have areas of green healthy tissue alternating with brown infected tissue in a pronounced banded appearance. As the disease progresses, stems turn completely brown and defoliate. Small, black-bodies are commonly observed scattered throughout infested leaf and stem tissues. Bolls may also be attacked. Yields may not be seriously affected when the disease appears after flowering. When the disease becomes established before or during flowering and weather conditions are favorable for fungus to spread, yield losses may be extensive. For further information, see Fact Sheet 196, "Pasmo of Flax."

ASTER YELLOWS: This disease is characterized by a yellow, stunted growth; contorted foliage; distortion and proliferation resulting in the development of prominent yellow, star-shaped floral parts; and failure of boll formation. Usually, the entire plant is involved but sometimes only a portion of the plant appears to be infected.

For many years this disease was considered to be caused by a virus. However, in 1968 it was established that it is not a virus disease and that the causal agent is a bacterial-like organism called Mycoplasma. While aster yellows occurs to some extent in most years, the development of widespread epidemics is associated with those years in which high populations of the six-spotted leafhopper occur early and persist for some time during the crop season. All varieties apparently are equally susceptible.

SEEDLING BLIGHT: Soil-borne fungus organisms cause seedling blights. These organisms attack the stem just below the soil surface. Infected plants frequently die, resulting in drastic thinning of the stand. Unfavorable environmental conditions favor outbreaks of the disease. All varieties are more or less susceptible. Cracked or split seedcoats favor development of seedling blight. The use of treated, sound, healthy certified seed with as low a percentage of cracked seed os possible, along with good management practices, appear to be the best protection against this disease.

Recommended Plant Varieties

Flax variety recommendations are based on unbiased Agricultural Experiment Station yield test results, disease resistance, market quality and consistency of performance.

It's a sound practice to replace home-grown seed with certified seed of current recommended varieties every 3 or 4 years. Surveys indicate that much of the flax now being grown is actually a mixture of varieties which are susceptible to rust. *Linott* and *Culbert* are the only varieties recommended in South Dakota because of their resistance to all races of rust. Growers planting common Linott should have it tested by the Plant Science Department, South Dakota State University, to determine the percent of rust-susceptible plants. Norstar is resistant to race 370 but is susceptible to the new races, 371 and 372. When susceptible varieties are planted, they should be planted early (April 15 to April 25) to avoid excessive yield loss from rust. Planting a susceptible flax variety late could result in a complete loss if a heavy rust infestation occurs. By using certified seed and following the best cultural practices, flax growing can be a successful enterprise.

Flax variety recommendations according to crop adaptation areas, are given each year in the current fact sheet on Field Crop Varieties.

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